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Cavefishes of Meghalaya

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Abstract

The state of Meghalaya, in northeast India, has many caves in the Jaintia, Khasi and Garo Hills districts. As per the available reports, over 1000 caves have been explored or partially explored to yield over 450 kilometres of surveyed cave passage in the state. The true cave-adapted species or troglobionts mostly occupy the cave's deep zone, while some casual or occasional visitors are found at the entrance or to a depth of some extent. The troglobionts are characterized by depigmentation or albinos and, ultimately, lack of vision or very regressed vision with highly developed extra-ocular sensitive organs. In the 23rd February 2020 episode of Mann Ki Baat, the Prime Minister of India shared amazing facts about a rare fish species found by the biologist in the cave of Meghalaya and remarked that it is the largest among the cave-dwelling species existing in deep underground caves where even light cannot reach. After detailed molecular analyses, scientists found that the world's largest cavefish from Meghalaya was a new species named *Neolissochilus pnar*. The present report documents for the fist time, a list of four true troglobiont species found only in the caves of Meghalaya, namely, *Schistura sijuensis*, *Schistura papulifera*, *Schistura larketensis* and *Neolissochilus pnar*. The Maan Ki Baat episode provided the insights to document the cave fishes of Meghalaya which will provide awareness to the stakeholders and local communities to conserve the cave fauna and their unique habitat.

Keywords: Cavefish, troglobiont, subterranean, Meghalaya, India

Introduction

Meghalaya is home to more than 1000 caves, including India's longest and deepest caves and ranks among the top 10 caving destinations in the world. These caves spread along the state's southern boundary from west garo hills, west and east Khasi Hills and Jaintia Hills. The abundance of caves in Meghalaya is due to the prevailing conditions of high-quality limestone, abundant rainfall, high elevation, and a hot and humid climate. The Siju cave in Southern Garo Hills was first explored in 1875 by Mr Sanderson, the then Superintendent of the Government *Kheddans* or *elephant-catching operations* in Garo Hills, followed by Mr T.D. La Touche of the Geological Survey of India in 1881. The first collection of cave fauna was made by Mr R. Friel, the then Deputy Commissioner of the Garo Hills, who visited the cave in 1919. Subsequently, in 1922, Kemp and Chopra of the Indian Museum explored the faunal resources of the cave up to 3900 ft inside from the entrance. They discovered 102 species, including eight species of fish – *Psilorhynchus sucatio, Neolissochilus hexastichus, Barilius bendelisis, Barilius barna, Danio aequipinnatus, Chanda nama, Channa gachua* and one *Nemachilus* sp. (Kemp and Chopra, 1924; Hora, 1924). Pillai and Yazdani (1977) studied the ichthyofauna of Garo hills and recorded three more species– *Neolissochilus hexagonolepis, Tor tor* and *Schistura multifasciata* from the cave. Menon (1987) described *Schistura sijuensis* from the Siju cave.

The Meghalaya Adventurers Association (MAA), in collaboration with international speleologists, began a comprehensive exploration of the caves of Meghalaya in the early 1990s. Through these expeditions, three more new subterranean fish species were added. Kottelat et al. (2007) described *Schistura papulifera* from Synrangpamiang cave in east Jaintia hills. Ten years later, an expedition to Khung, a limestone cave near Larket village in east Jaintia hills, revealed another nemacheilid fish described as *Schistura larketensis* by Choudhury et al. (2017). In another expedition in 2019, Harries discovered the world's largest known subterranean fish related morphologically to the golden mahseer, *Tor putitora,* from Krem Umladaw of east Jaintia hills. In the 23rd February 2020 episode of Mann Ki Baat, the Honourable Prime Minister, shared amazing facts about a rare fish species found by the biologist in the cave of Meghalaya and remarked that it is the biggest among the cave-dwelling species. It exists in deep underground caves where even light cannot

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reach easily, and scientists are puzzled at the ability of this large fish to survive in such deep caves, thereby lending a new facet to India's biodiversity. Dahanukar *et al.* (2023) further studied the genetic analysis of the species from fresh specimens and formally described the world's largest cavefish as *Neolissochilus pnar*.

Material and Methods

The cavefish specimens available in the National Zoological Collections of Zoological Survey of India (ZSI), Kolkata and North East Regional Centre, ZSI, Shillong have been examined. Photographs of the specimens are taken using Nikon D7000. The classification of fishes follows Fricke *et al.* (2023) and species under a genus followed an alphabetic sequence. Information were taken from Kottelat *et al.* (2007) for *Schistura papulifera*; Choudhury *et al.* (2017) for *Schistura larketensis;* Menon (1987) for *Schistura sijuensis* and Dahanukar *et al.* (2023) for *Neolissochilus pnar.*

Results and Discussion

Four troglobiotic fish species of the order Cypriniformes have so far been discovered from the caves in Meghalaya. Among them, three species belong to the family Nemacheilidae, and one is under Cyprinidae. Systematic accounts of the cavefishes of Meghalaya are furnished below:

Systematic accounts of the cavefishes of Meghalaya

Order: CYPRINIFORMES

Family: NEMACHEILIDAE

1. ***Schistura larketensis*** Choudhury *et al.*, 2017

(Figure 1)

2017. *Schistura larketensis* Choudhury, Mukhim, Basumatary, Warbah and Sarma, Zootaxa 4353(1): 89-100 (Type locality: Krem Khung, 1.5 km from Larket village, East Jaintia Hills, Meghalaya, India).

Figure. 1. *Schistura larketensis* Choudhury *et al.*, 2017.

Material examined: ZSI FF 7225, paratype, 1 ex., 60.0 mm SL, India, Meghalaya, East Jaintia Hills, Krem Khung, 1.5 km from Larket village, 24-2-2016, Coll. D.K.B. Mukhim & Party.

Diagnosis: *Schistura larketensis* differs from its congeners in possessing a combination of the following characters: a pale to weakly-pigmented body; a thick and short basicaudal bar immediately below the lateral-line scale row (often appearing broken in some individuals); the eyes vestigial or absent; a smooth ventrolateral surface of the head; the anterior nostrils forming long and pointed triangular tube-like flaps; an incomplete lateral-line; a small and cylindrical, axillary pelvic-lobe; the chest naked; and an emarginated caudal-fin.

Distribution: India: Krem Khung cave, Meghalaya.

Elsewhere: Not recorded.

Remarks: *Schistura larketensis* was described from Krem Khung, about 1.5 km from Larket village, East Jaintia Hills District of Meghalaya (Figure 2). The species

differs from *Schistura papulifera*, its only troglomorphic congener from northeast India, in having a smooth ventral surface of the head and a small cylindrical axillary pelvic lobe and the presence of three pores in the supratemporal canal of the cephalic lateral-line system. Apart from these differences, the species can be immediately distinguished from all other species of *Schistura* from the Brahmaputra River and neighbouring basins by the complete absence (or only vestigial presence) of eyes. The conservation status of the species is yet to be evaluated.

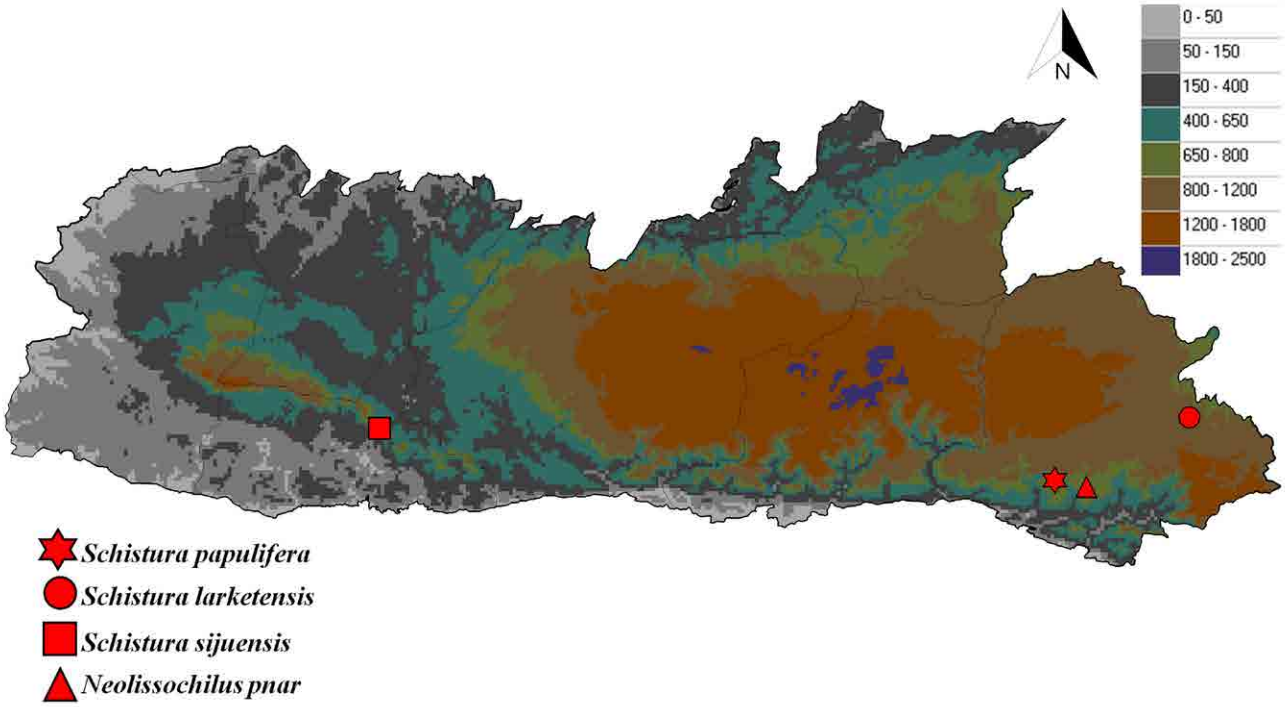

Figure 2. Map of Meghalaya showing the distribution of *Schistura papulifera, Schistura larketensis*, *Schistura sijuensis* and *Neolissochilus pnar*.

2. ***Schistura papulifera*** Kottelat *et al*., 2007

(Figure 3)

2007. *Schistura papulifera* Kottelat, Harries and Proudlove. Zootaxa, 1393: 36, figs. 1-3 (Type locality: Cave of synrangpamiang system, Jaintia Hills, Meghalaya, India).

Figure 3. *Schistura papulifera* Kottelat *et al.*, 2007

Material examined: None. Reported in Kottelat *et al.* (2007).

Diagnosis: It is distinguished from all other known species of *Schistura* in having the lower half of the head

covered by small skin projections and five pores in the supratemporal canal of the cephalic lateral-line system. In addition, it has a white body and vestigial eyes.

Distribution: India: Cave of synrang pamiang system, Jaintia Hills, Meghalaya.

Elsewhere: Not recorded.

Remarks: *Schistura papulifera* is currently known with certainty only from the Krem Synrang Pamiang system in the Jaintia Hills, eastern Meghalaya (Fig. 2). Synrang Pamiang is an extensive system with over 14 km of mapped cave passages and five known entrances. The species is considered to be Critically Endangered (CR) as it is known from a single location with a highly restricted extent of occurrence and area of occupancy with threats from mining and quarrying resulting in habitat loss and a decline in habitat quality. It is endemic to Meghalaya.

3. ***Schistura sijuensis*** (Menon, 1987)

(Figure 4)

1987. *Noemacheilus sijuensis* Menon, *Fauna of India,* Pisces, 4: 175, pl. 6, fig. 2 (Type locality: Siju cave, Garo Hills, Meghalaya).

Figure 4. *Schistura sijuensis* (Menon, 1987)

Material examined: Meghalaya, South Garo Hills district, Rongdi River, Sandong Sangma, 3 ex., 27.IX.2018. Reg. No. V/F/NERC/ZSI/4984, (alt. 92m; N: 25°22'50.38" N; 090°18'28.35"E), Coll. D. Khynriam & party.

Diagnosis: *Schistura sijuensis* is distinguished from its congeners having marked with 8-10 bands across back which break up into secondary bands below lateral line, complete lateral line, caudal fin forked with two V-shaped bands, 8 branched dorsal fin rays, 5 branched anal fin rays and 10 branched pectoral fin rays.

Distribution: India: Meghalaya.

Elsewhere: Not recorded.

Remarks: *Schistura sijuensis* was described by Menon in 1987 from the Siju cave of Garo Hills. The species is only recorded from the Siju cave in the Garo Hills, Meghalaya, India, and is categorized as endangered (EN) in the IUCN Red List. The main threats to this species are quarrying and mining for limestone. Deforestation is also reducing habitat quality as it produces siltation and habitat disturbance. No specific conservation measures are in place. It is endemic to Meghalaya.

Family: CYPRINIDAE

4. ***Neolissochilus pnar*** Dahanukar *et al.,* 2023

(Figure 5)

2023. *Neolissochilus pnar* Dahanukar, Sundar, Rangad, Proudlove and Raghavan., *Vertebrate Zoology,* 73: 143, figs. 1, 3 (type locality: Cave, 92 m below the surface in Krem Um Ladaw, Meghalaya, India)

Figure 5. *Neolissochilus pnar Dahanukar et al.,* 2023. *(*Source: *Prof Dandadhar Sarma, Guwahati University)*

Material examined: None. Reported in Dahanukar *et al.,* (2023).

Diagnosis: *Neolissochilus pnar* differs from all its congeners by having a long mandibular barbel, reaching anterior margin of opercle (vs. short, not reaching margin of opercle). It is further distinguished from its congeners by atrophied eyes, highly reduced in size in juveniles and small adults and absence of externally visible eyes in adults (vs. presence of well-developed eyes in all life stages); pectoral-fin reaching (vs. not reaching) the anterior base

Figure 6. A view of Siju cave in Meghalaya.

of pelvic fin; the complete lack of pigmentation (vs. presence); and distinct scalation pattern with 28+2 (2) or 31+1 (1) lateral line scales, eight scales in transverse series with four above the lateral line and three below the lateral line.

Distribution: India: caves at Krem Um Ladaw, and the adjacent Krem Chympe in Jaintia Hills, Meghalaya, India, which drain into the Meghna River System.

Elsewhere: Not recorded.

Remarks: The newly-discovered species belongs to *Neolissochilus,* a genus of freshwater fish in the family Cyprinidae. *Neolissochilus pnar* was discovered in the cave Krem Um Ladaw of Meghalaya. The species also occurs in another adjacent cave, Krem Chympe. The species is regarded as the world's largest cavefish species. The species is yet to be evaluated in IUCN Red List. *Neolissochilus pnar* grows to over 400 mm (1.3 feet) and occurs only in the limestone caves of Meghalaya, a state in northeastern India. It is endemic to Meghalaya.

Due to the endemism, extraordinary adaptation, and dire risk of extinction, cave-dwelling organisms are now a focus of immense interest worldwide. The above four species, viz., *Schistura papulifera*, *Schistura larketensis, Schistura sijuensis*, and *Neolissochilus pnar* are endemic in the Meghalaya state of India. The cave systems of Meghalaya were formed by the wearing away of limestone or calcium carbonate bedrock for millions of years. These habitats support significant and surprising life forms, categorised as *Troglophiles* (cave fauna but may also live outside), *Trogloxenes* (occasional visitors that hunt or roost in caves) and *Troglobites* or *troglobiont* or *stygobites* (true cave dwellers that are characterised by the absence of pigmentation, loss of eyesight and development of sensors suited to live in the absence of light). The documented (Hora, 1924; Kemp and Chopra, 1924; Kottelat *et al.,* 2007; Choudhury *et al.,* 2017; Harries *et al.,* 2019; Dahanukar *et al.,* 2023) cave faunal diversity includes the slug (*Pulmonata*), pseudoscorpion (*Pseudoscorpiones*), spiders (*Heteropoda robusta*, *H. fischeri*, *Tarantula* and *Oonops* sp.), clumps of harvestmen (*Opiliones*), shrimp (*Macrobrachium* sp.), crabs (*Teretamon absarum*, *Paratelphusa* sp.), woodlice (*Oniscoidea*, *Philoscia* sp.), millipedes (*Trachyiulus mimus*), springtails (*Collembola* sp), fungus gnat larvae (*Keroplatidae*), brown crickets (*Rhaphidophoridae*), troglomorphic cockroaches (*Spelaeoblatta caeca*), beetles (*Cholevidae*), flies (*Mycetophilidae*), pond skaters (*Gerridae*), gecko (*Gekkonidae*), bats (*Microchiroptera*, *Murina jaintiana*, *Optomops wroughtoni*, *Myotis pussillus*) and fish (*Schistura sijuensis, Schistura papulifera*, *S. larketensis*, *Neolissochilus pnar*). The cave systems also hold records of marine creatures like molluscs and protozoa fossilised in limestone. Most of the cave systems in Meghalaya are rainfed and remain flooded during monsoons (Figure 6). The caves in east Jaintia hills are the most vulnerable due to anthropogenic activities like mining, quarrying and dumping of wastes which ultimately leads to high siltation, pollution and acidification of the main streams. Of the four troglobiont species of Meghalaya, International Union of Conservation of Nature assessed two species: *Schistura papulifera* and *Schistura sijuensis* as threatened (Vishwanath, 2020). The fish *Schistura papulifera* of the Pamiang cave system is moved to the critically endangered category due to its fragile habitat (Vishwanath, 2010). Therefore, active cooperation and participation at the local, district and state levels are paramount to preserving the hidden treasures of the cave ecosystems.

Caves are not just the home to a wide variety of fauna and flora, but some caves also act as a reservoir for the villagers to fulfil their daily needs, mainly in drinking water supply. Environmental problems like deforestation have a significant impact on altering the environment and the biodiversity inside the caves. Another problem that affects the biodiversity inside the caves is Acid Mine Drainage, a runoff from coal mines and open coal storage areas that leeches into the soil and flows into the river. Therefore, the conservation of cave biota is vital for its aesthetic value. The most important is that Meghalaya is the home of the most important karst of the Indian continent and has a high potential for studies and research in the future. The National Green Tribunal has banned illegal mining activities in the state. Our knowledge of the hidden subterranean diversity is limited due to its fragile and inaccessible habitats.

Due to the endemism, extraordinary adaptation, and dire risk of extinction, cave-dwelling organisms are now a focus of immense interest worldwide. As emphasized by the Honourable Prime Minister of India in his Maan Ki Baat, the occurrence of a new cavefish species is a matter of joy that India, especially Meghalaya, is home to a rare species; the Zoological Survey of India has documented a list of four *Troglobites* fish species found only in Meghalaya with their photographs and systematic accounts. The

Maan Ki Baat of the Honourable Prime Minister on new cavefish in Meghalaya provided awareness to the different levels of stakeholders, including the local communities, thereby evoking people's minds to conserve the cave habitat and its fish fauna. Further scientific investigations and explorations are required to conserve the cavefish diversity and their unique habitat.

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References

Choudhury, H., Mukhim, D.K.B., Basumatary, S., Warbah, D.P. and Sarma, D. 2017. *Schistura larketensis*, a new cavernicolous fish (Teleostei: Nemacheilidae) from Meghalaya, Northeast India. *Zootaxa*, **4353**(1): 89-100.

Dahanukar, N., Sundar, R.L., Rangad, D., Proudlove, G. and Raghavan, R. 2023. The world's largest cave fish from Meghalaya, Northeast India, is a new species, *Neolissochilus pnar* (Cyprinidae, Torinae). *Vertebrate Zoology* **73**: 141-152.

Fricke, R., Eschmeyer, W. N. and Fong, J. D. 2020. Species by family/ subfamily. (http://researcharchive.calacademy.org/researh/ichthyology/catalog/Species ByFamily.asp). Electronic version accessed 20 Apr 2023.

Harries DB, Arbenz T, Dahanukar N, Raghavan R, Tringham M, Rangad D, Proudlove G (2019) The world's largest known subterranean fish: A discovery in Meghalaya (NEIndia) of a cave-adapted fishrelated to the Golden Mahseer, Tor putitora (Hamilton 1822). *Cave and Karst Science,* **46**: 121–126.

Hora, S.L. 1924. Fish of the Siju cave, Garo Hills, Assam. *Rec. Indian Mus.,* **26**: 27-31.

Kemp, S. and Chopra, B. 1924. The Siju cave, Garo Hills, Assam. Part I: *Rec. Indian Museum,* **26**: 3-22.

Kottelat, M., Harries, D.R. and Proudlove, G.S. 2007. *Schistura papulifera*, a new species of cave loach from Meghalaya, India (Teleostei: Balitoridae), *Zootaxa,* **1393**: 35-44.

Menon, A.G.K. 1987. The fauna of India and the adjacent countries. Pisces. Vol. IV. Teleostei-Cobitoidea. Part 1. Homalopteridae. Zoological Survey of India, Calcutta, x+259 pp, 16 pls.

Pillai, R.S. and Yazdani, G.M. 1977. Ichthyo-fauna of Garo Hills, Meghalaya (India). *Rec. zool. Surv. India:* **72**: 1-22.

Vishwanath, W. 2020. *Schistura sijuensis* (amended version of 2010 assessment). *The IUCN Red List of Threatened Species* 2020:e.T19977A177145523. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T19977A177145523.en. Accessed on 18 April 2023.

Vishwanath, W. 2010. *Schistura papulifera*. *The IUCN Red List of Threatened Species* 2010: e.T168546A6511934. https://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T168546A6511934.en. Accessed on 18 April 2023.